The Sidereal Messenger.

Conducted by WM. W. PAYNE, Director of Carleton College Observatory.
Northfield, Minn.

"In the present small treatise I set forth some matters of interest to all observers of natural phenomena to look at and consider."—GALILEO, *Sidereus Nuncius*, 1610.

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THE NUCLEUS OF THE GREAT COMET OF 1882.

BY H. C. WILSON.

The following tables give the results of my measures of the nucleus or nuclei of the Great Comet of 1882. The measures were made with the filar micrometer of the 11-inch equatorial, and generally with an eye-piece magnifying 90 times. I frequently examined the nucleus with a magnifying power of 450, but found it easier to make the measures with power ninety.

The parts of the nucleus are designated n_0, n_1, n_2 and n_3 in the order of their passage through the field of the telescope. n_0 is the preceding end of the nucleus, n_1, n_2 and n_3 three bright points. n_1 and n_2 had perceptible discs which were visible in the dawn for some time after the remainder of the comet was invisible. On October 5, I estimated their diameters with power 450, to be $1.''5$ (n_1) and $3''$ (n_2), which would be equivalent to about 900 miles and 1,800 miles.

XUM

The discs were plainly visible October 4, 5, 6, 12 and 13. After October 13 the hazy envelope around them became so thick that they were indistinct. The bright points n_1 and n_2 could, however, be recognized up to November 29, and n_2 was visible on January 31 and February 8. n_3 was very minute and obscured by a mass of hazy matter which seemed to be emitted sometimes from n_2 and sometimes from n_3 n_3 was easily seen from October 4 to November 3, but was very difficult of measurement. Between n_1 and n_0 the nucleus was continuous and appeared very much like a tail to n_1. Within this at times I saw two other very bright minute points.

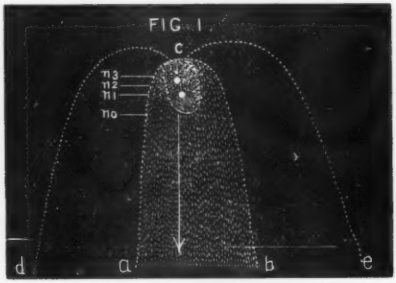


Figure 1 gives the outlines of the head and nucleus on October 19. *a c b* is the head of the bright part of the comet. The matter included by the curves *c d* and *c e* was very faint, but I saw it distinctly from October 13 to November 7. The arrow shows the direction of the motion through the field of the telescope, or position angle 270°.

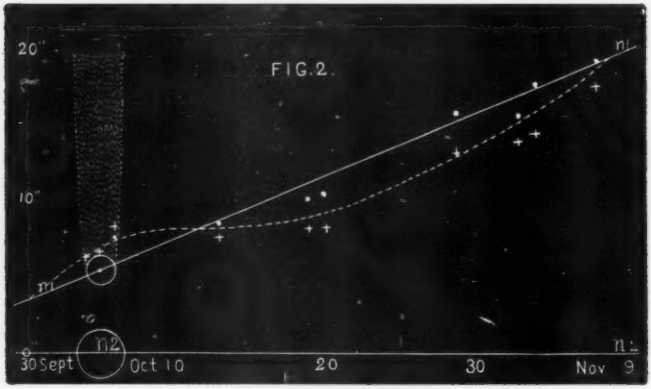
In the table p is the observed position angle and s the observed distance of the parts of the nucleus; p_0 is the computed position angle of the radius vector prolonged. $p-p_0$ is therefore the apparent angular deviation of the parts of the nucleus from the direction toward or opposite the sun. φ is this deviation reduced to the plane of the comet's orbit; Δ is the distance of the parts reduced to the same plane. The measures of distance for n_2 n_1 and n_3 n_2 were quadruple measures, those for n_1 n_0 single.

Greenwich M.T.	p	p_0	$v-p_0$	s	φ	Δ
October 5.937	280°.4	265°.3	+ 15°.1	30.″est	+ 22°.9	
6.971	281 .9	265 .7	+ 16 .2		+ 23 .4	
12.971	285 .2	268 .1	+ 17 .1		+ 21 .6	
13.923	288 .1	268 .4	+ 19 .7	16. 1	+ 23 .0	0.000267
19.937	293 .7	271 .1	+ 22 .6	29. 6	+ 22 .7	0.000507
20.964	290 .9	271 .4	+ 19 .4		+ 20 .4	
			n_2 n_1			
4.951	277 .0	264 .9	+ 12 .1	10.	+ 20 .5	
5.937	278 .6	265 .3	+ 13 .3	5. 6[illegible]		
5.965	280 .2	265 .3	+ 14 .9	5. 40	+ 21 .9	0.000082
6.971	281 .9	265 .7	+ 16 .2	7. 58	+ 23 .4	0.000120
12.971	285 .2	268 .1	+ 17 .1		+ 21 .6	
13.923	285 .2	268 .4	+ 16 .8	8. 35	+ 21 .0	0.000130
19.937	286 .6	271 .1	+ 15 .5	10. 03	+ 17 .8	0.000150
20.964	286 .6	271 .5	+ 15 .1	10. 20	+ 17 .2	0.000151
29.930	293 .2	275 .4	+ 17 .8	15. 84	+ 16 .3	0.000248
Nov. 2.981	295 .2	278 .2	+ 17 .0	15. 90	+ 15 .1	0.000233
3.947	294 .7	278 .8	+ 15 .9	17. 65	+ 14 .1	0.000264
7.926	303 .3	281 .3	+ 22 .0	19. 15	+ 16 .8	0.000320
			n_3 n_2			
October 4.951	274 .0	264 .9	+ 12 .0		+ 20 .5	
5.937	277 .4	265 .3	+ 12 .	6 .26	+ 20 .0	0.000088
6.971	281 .9	265 .7	+ 16 .2		+ 23 .4	
12.971	285 .2	268 .1	+ 17 .1		+ 21 .6	
13.923	285 .2	268 .4	+ 16 .8	9 .8[illegible]	+ 21 .0	0.000154
19.937	286 .6	271 .1	+ 15 .5	9 .01	+ 17 .8	0.000135
20.964	290 .6	271 .5	+ 19 .1		+ 20 .2	

Elongation of the whole nucleus.

Greenwich M. T.	p	p_0	$p-p_0$	φ	Ratio of length to width.
September 18.287	°	°	°	°	1 : 1
18.978					1 : 1
24.962					1 :
October 4.951	277.0	264.9	+ 12.1	+ 20.4	
5.937	280.0	265.3	+ 14.7	+ 22.5	
6.971	281.9	265.7	+ 16.2	+ 23.4	4 1
12.971	285.2	268.1	+ 17.1	+ 21.6	4 1
13.923	286.7	268.4	+ 18.3	+ 22.0	
19.937	290.4	271.1	+ 19.3	+ 20.6	6 : 1
20.964	289.4	271.5	+ 17.9	+ 19.3	
29.930	293.2	275.4	+ 17.8	+ 16.3	5 : 1
November 2.981	295.2	278.2	+ 17.0	+ 15.1	5 : 1
3.947	294.7	278.8	+ 15.9	+ 14.3	
7.926	303.3	281.3	+ 22.0	+ 16.8	138″ : 65″
20.995	315±	291.3	+ 24±	+ 15±	
January 31.003	51.0	49.6	+ 1.4	+ 0.8	
February 8.602	70.2	59.8	+ 10.4	+ 14.0	173″ : 71″
28.631	69.2	78.0	− 8.8	− 11.6	
March 2.613	72.9	79.4	− 6.5	− 12.2	2 : 1

Comparing these results, it seems to me that they agree best when reduced to the plane of the orbit, this indicating that the parts of the nucleus were in that plane. The minus signs of the last two angles φ would perhaps indicate the contrary; but the comet was so faint on those dates that little reliance can be placed on the measures then made. On the whole there seems to have been a gradual decrease in the angle of deviation from the radius vector.



The distance between the parts of the nucleus increased at an almost uniform rate. If we plot the distance for n_2 n_1 we find that they may be represented approximately by a straight line. If we extend this line backward we find it meets the zero line about September 20, which suggests the inference that the division of the nucleus took place at about that time. The first recorded observation of the divided nucleus which I have been able to find, however, was on the morning of September 30, and it has been stated definitely by various observers that the nucleus was not divided previous to this date.

In my observations of the position of the nucleus I generally took the transits of all the parts of the nucleus, but measured the declination of only n_2. From the differences in time of transit we may also derive the distances of the

nuclei by the formula $S = da \cos\delta \operatorname{cosec} p$. The results thus obtained are shown in the following table:

		$d\,a$			Number of Transits	$s = da \cos\delta \operatorname{cosec} p$		
		$n_0\,n_2$	$n_1\,n_2$	$n_2\,n_3$		$n_0\,n_2$	$n_1\,n_2$	$n_2\,n_3$
		s	s	s		"	"	"
October	4		0.40		9		6.0	
	5		0.42	0.42	6		6.3	6.3
	6	1.17	0.54	0.36	10	17.7	8.2	5.4
	13	1.64	0.49	0.45	6	24.6	7.4	6.8
	19		0.53		6		8.0	
	20		0.53		8		8.0	
	29		0.85		14		13.0	
November	2	3.21	0.89	0.79	20	50.0	13.8	12.2
	3	3.85	0.92	0.81	10	59.6	14.2	12.5
	7	3.96	1.05		10	65.9	17.4	
	20	3.86			6	73.4		

These distances show about the same rate of increase as the direct measures. It is curious however that, with the exception of the first three of $n_1\,n_2$, they are all less than the direct measures by about the same amount. On figure 2 these distances of $n_1\ n_2$ are plotted, the direct measures being represented by dots and the measures by transits by crosses. The circles represent the size of the discs n_1 and n_2 as estimated by me October 5. The direct measures are fairly represented by the straight line $n_1\,n_1$ which crosses the zero line at about September 20. Excepting the first three, the measures by transits might be represented by another straight line parallel to the former and distant from it about 2″, which would be my *personal equation* for the two methods of measurement. Combining two sets of measures, they seem to indicate a curve something like the dotted line. This curve is quite similar to that obtained by Dr. Schmidt of Athens from his measures of $n_0\ n_2$ (*c b*; Astronomische Nachrichten No. 2499).

Variable Stars.—The large telescope, Harvard College observatory, has been recently used in observing variable stars, too faint to be visible with the west equatorial. The collection of data for charts of the immediate neighborhood of many variable stars has also been undertaken with the large telescope.

THE ZONE OF ASTEROIDS AND THE RING OF SATURN.*

PROFESSOR DANIEL KIRKWOOD.

Evidence in support of the following theses was published by the present writer in 1866–7.

I. In those parts of the zone of minor planets where a simple relation of commensurability would obtain between the period of an asteroid and that of *Jupiter*, the original planetary matter was liable to great perturbation. The result of such disturbance by the powerful mass of *Jupiter* was the necessary formation of gaps in the asteroid zone.

II. The great division in the ring of *Saturn* may be explained by the disturbing influence of the satellites, and the more narrow division discovered by Encke may be regarded with much probability as the effect of a similar cause.†

The recent able and noteworthy papers of General Parmentier‡ of Paris and Dr. Meyer,§ of Geneva, have invested these older discussions of the same subjects with fresh interest and importance. The actual discovery of chasms in the asteroid ring was the result of a previous theoretical determination of the parts where void spaces would be produced by *Jupiter's* influence. The definite claims of the writer then are:

(1.) To have designated the theoretical positions of gaps in the zone of asteroids.

(2.) To have shown that these divisons actually exist; and

(3.) To have first assigned a physical cause for the divisions of *Saturn's* ring.

A restatement of the principal evidence, showing the har-

*Read before the American Philosophical Society, Oct. 5, 1883.

†See Proc. A. A. A. S., 1866 and 1875; Met. Ast. Ch. xii; Monthly Notice, R. A. S. Jan. 1869; Proc. A. P. S., vol. xii, p. 163; Smithsonian Rep. 1876; London Observatory, July, 1882.

‡L'Astronomie, for June, 1883.

§Astr. Nach., No. 2527.

mony of recent discoveries with the conclusions announced seventeen years since, is given below. The portions of the ring in which the periods would be commensurable with that of *Jupiter* are

1. *The distance 3.2776.* At this distance a planetary mass would make precisely two revolutions while *Jupiter* completes one. Hence, as has been frequently shown, a chasm in the ring would be the probable consequence of *Jupiter's* disturbing influence. How far is this theoretical inference sustained by facts?

An examination of the table of distances shows:

Between 3.083 and 3.220.....37 asteroids
" 3.220 and 3.357..... 0 "
" 3.357 and 3.494..... 8 "

That is, the part of the zone just within the distance at which a planet's period would be one-half that of *Jupiter*, contains the extraordinary number of thirty-seven minor planets, while the next space of equal breadth (that containing the distance 3.2776), is a total blank, not a single asteroid having yet been found within it. The exterior space immediately adjacent, and of the same extent, contains eight. The confirmation of the theory is thus most striking in precisely that part of the zone where we have most reason to expect it.

2. *The distance 2.5012.* Here an asteroid's period would be one-third that of *Jupiter*. The order of commensurability would be less simple, but the results of perturbation would be of the same nature. The part of the zone included between the distances 2.30 and 2.80 contains 143 minor planets; 45 within the critical distance and 98 exterior to it. The average interval between adjacent members is 0.00349, while that containing the distance 2.5012—between Thetis and Hestia—is 0.05386, or more than fifteen times the average. Or, if we take spaces adjacent to the chasm and of equal breadth with it, we find twenty asteroids in the interior and eighteen in the exterior.

3. *The distance 3 70.* Here five periods of a minor planet would be equal to three of Jupiter. The distance falls in

the wide hiatus interior to the orbits of Hilda and Ismene.

4 *The distance 2.82.* At the distance 2.82 five periods of an asteroid would be equal to two of *Jupiter*. The difference between the two terms of the ratio is three, and hence the conjunctions would occur at angular intervals of 120°. Between the distances 2.753 and 2.803 we find twenty-three minor planets. In the next space of equal breadth, containing the distance 2.82, there is but one. This is No. 188, Menippe, whose elements are still somewhat uncertain. Between 2.853 and 2.903 we find ten asteroids.

Several other gaps have been noticed, but they become less distinctly marked as the cases of commensurability become less simple. Those considered are the only cases in which the conjunctions would occur at less than four points of the asteroid's orbit.

The orbit of Hilda is doubtless nearly, if not quite, the outer limit of the zone. Its mean distance is 3.9523, and in the space immediately beyond—at the distance 3.9683—an asteroid's period would be two-thirds of *Jupiter's*. It may be observed, moreover, that at the distance 2.063, just within the orbit of Medusa, a minor planet would make four revolutions to *Jupiter's* one.

Are the gaps in the zone accidental?—In 1870, before half the asteroids now known had been discovered, Mr. Proctor, the well-known astronomer, wrote:

"The question may be suggested, however, is it not possible that the gaps thus apparent are merely accidental, and their accordance with the mean distances simply another accidental coincidence? It may seem, at first sight, that we have not as yet determined the orbits of a sufficient number of asteroids to decide very positively on this point. If another hundred were discovered, it might well happen, one would suppose, that the gaps would be filled up. But, in reality, the doctrine of chances is wholly opposed to this supposition. A law, such as that exhibited in the figure,* does not present itself without a cause. Irregularity is to

*Mr. Proctor's diagram was mearly a graphic representation of the groups and chasms of the zone.

be observed in all chance combinations, and the figure may be said to exhibit irregularity. But irregularities resulting purely from accident, never by any chance (when a fairly large number of cases is taken) simulate, so to speak, the operation of law. Therefore we may assume that when many more asteroids have been discovered, the law exhibited in the figure will appear even more distinctly."*

One hundred and twenty minor planets have been added to the list since this passage was written, and, as was then predicted, the chasms in the zone have been rendered the more obvious.

In three portions of the ring the clustering tendency is distinctly evident. There are from 2.35 to 2.46, from 2.55 to 2.80 and from 3.05 to 3.22; containing forty-three, ninety-six, and forty asteroids, respectively. We have thus an obvious resemblance to the rings of Saturn; the partial breaks or chasms in the zone corresponding to the well-known intervals in the system of secondary rings.

The rings of Saturn.—In the writer's Meteoric Astronomy published in 1867. the same principle employed to explain the chasms in the ring of minor planets was shown also to account for Cassini's division in *Saturn's* ring; and in a paper read before the American Philosophical society, on the 6th of October. 1871, the division discovered by Encke was explained in like manner. The details of these calculations need not here be repeated, especially as Dr. Meyer has quite recently discussed the whole subject, not only confirming the conclusions of the present writer, but indicating also other parts of the ring where the satellites unite in exercising special disturbing influences. So exhaustive is Dr. Meyer's discussion that "the correspondence between calculations and observation, as to the division of *Saturn's* rings, would now seem to be complete."

The discovery of a comet reported from Key West, on the morning of January 16, was a mistake. The Pons-Brooks' comet was the one seen.

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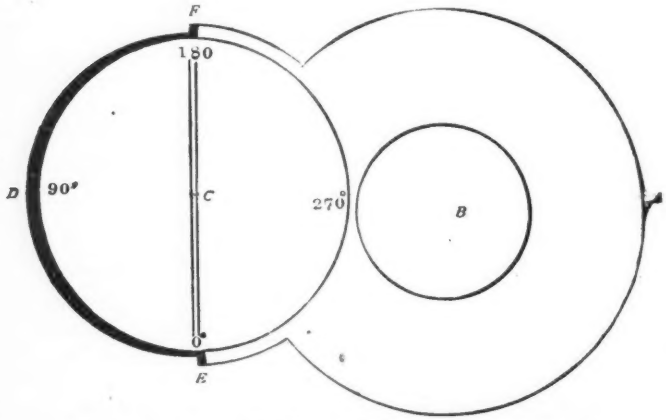
*Intellectual Observer, vol. iv. p. 22.

A HANDY MICROMETER.

BY NEWTON M. MANN.

This article is not written for professional observers with ample equipments. Their derision is deprecated at the outset, and the plea is put in that the suggestions to be made are only for amateurs, having telescopes of moderate aperture, equatorially mounted, and either fixed or capable of being readily placed in good position. The instrument I shall propose has not the accuracy of the filar micrometer. Still it is very convenient, and from somewhat extended experiment I venture to think that something can be done



with it in the way of fairly approximate measurement.

More than a century ago SIR WM. HERSCHEL wrote in his journal:

"I saw with one eye the projection of the stars (Castor), upon a wall at a distance of about six or seven feet, where they seemed to take up a space of four or five inches. I shall endeavor to construct a micrometer from this hint which may serve to measure such a very small interval exactly."

This phenomenon which is often taken advantage of by microscopists to trace under one eye beside the microscope

an outline of the object seen with the other through the instrument, and which is explained by Professor LE CONTE, (see "Sight" p 245) as "the heteronymous shifting of the two fields of view," I had often noticed before seeing this note of HERSCHEL'S; and I presume it is familiar to most persons who use a telescope. It occurred to me that it might afford a means of taking, at least roughly, the position angle of a double-star, and, after various experiments, I hit upon the following as the best device:

A sheet of brass is cut in the form of the figure *a d*, opposite, and fastened to the end of the large tube of the telescope, the tail-piece passing through the orifice *b*. On the arm *f d e* is laid a circle, graduated to degrees, and turning on the pivot *c*. This circle is blackened, and crossed by two bright parallel lines running from 0° to 180°. (In practice it may be covered with bright lines, parallel to these.) The graduation is in the reverse way from the ordinary position micrometer. At *e* and *f* are the indexes with fixed verniers. The instrument is fastened firmly on the telescope so that a line, drawn through the centers, *b c* shall be in the plane of the declination axis.

Now, with a small lamp behind us shining upon the circle, we turn our telescope upon a double-star. The image of the pair, of which HERSCHEL speaks, falls upon the circle, which we revolve until the two lie exactly between the parallel lines. We then take the reading from the index, *e*. In this case we use the right eye. When the telescope is turned over in the other position, it is necessary to use the left eye; the index *f* is then to the north, and the reading is taken from it.

An optical discrepancy remains to be guarded against. If you take an opera-glass, place your right eye to the left eye-piece, leaving your left eye free, and look at a bright line on the wall, or the top of a gilt picture frame, and, by this same heteronymous shifting of the two fields of view, try to bring the shadowy image of that line to the line itself as seen by your left eye, you will find that they cannot be made to coincide. The left end of the shadowy image drops

below the line. Put the glass to the left eye in the same way, and the right end of the image falls below. This interesting experiment the reader can make without moving from his chair.* The angle of deflection is about $2\frac{1}{2}°$ — rather more, in my case 2°.7. In other words, a line, to appear horizontal to the right eye, must have the left end raised $1\frac{1}{4}°$, or a little more. To appear horizontal to the left eye, it must have the right end raised to the same extent. Thus in the use of our instrument, the direction of a line joining the stars, seen by one eye is deflected one way $1\frac{1}{4}°$; and the parallel lines on the circle, as seen by the other eye, appear turned $1\frac{1}{4}°$ in the opposite way, making the reading when the right eye is at eye-piece $2\frac{1}{2}°$ too great; when the left eye is at the eye-piece $2\frac{1}{2}°$ too little. This is remedied by moving the index, *e*, $2\frac{1}{2}°$ farther from *d*, and the index, *f*, $2\frac{1}{2}°$ nearer *d* than they would fall if placed at right angles with a line joining the centers, *b*, *c*.

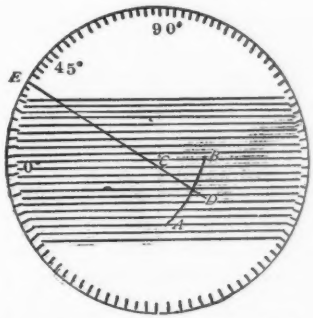
Measurements of distance may also be obtained with this instrument, attachments for this purpose will readily occur to any one who undertakes to use it.

HERSCHEL's method was to project the image of the stars upon a screen ten feet distance, where he found with a power of 460 the scale was one-fourth of an inch to the second. Suppose our instrument be one foot from the eye; then, according to this, the distance suptended by one second should be $\frac{1}{1\,0}\ \pi$ of $\frac{1}{4}$ inch, = .00795 inches. With a power of 230 this would be ten seconds to the millimetre. Probably eyes differ, and each observer would need to make

*This optical phenomenon I have not found anywhere well cleared up. PROF. LE CONTE, in the work already referred to, pp. 197, 198, represents Helmholtz as saying that "the *apparent* vertical meridian does not coincide with the *real* vertical, but makes with it in each eye an angle of $1\frac{1}{4}°$", as I find to be the case. But he adds, "The *horizontal* meridians of the eyes, both real and apparent, coincide perfectly." "In order that a line shall appear perfectly vertical to one eye it must incline $1\frac{1}{4}°$", etc "*But a horizontal line appears truly horizontal.*" This is certainly not the case with me, but the superposed image of a horizontal line has the same inclination as that of a vertical line. If there are eyes with which this is not so, of course the instrument above described would be found inaccurate in certain positions of the observer to the extent of $2\frac{1}{2}°$.

his own scale. With the last named above conditions I take much less than ten seconds to the millimetre. The method I have taken for distance is simple, and may be briefly described; premising that it is only for convenience in rough approximations.

Fig. 2.



Let Fig. 2 represent our graduated circle covered with fine parallel lines as before indicated the central line through *c* being conspicious. We have taken the position of a pair, let us say, whose angle is 0°, and revolved the circle one quadrant. The distance spanned by stars 90″ apart (with the eye-piece commonly used) has been carefully found by experiment, and the point *a* is made at this distance, and in a line perpendicular to the parallels, from the center, *c*. The pointer, *d e*, turns on the pivot, *c*, and has the longer arm a semi-diameter of the circle. Knowing the distance coresponding to 1″ as *m*, and the sine of 1° on the graduated circle as *n*, the distance *c b* is made to *c e* as *m* is to *n*. The points *a* and *b* are then joined by a curve of sines. The short arm of the pointer terminates in a silver wire which sweeps this curve, and the distance of its intersection therewith from the parallel passing through *c* may be read in seconds from the pointer *e* on the graduated periphery from 1″ up to 90″, each degree counting as one second. Such measurements, however, are attended with much more difficulty and uncertainty, as every change of position is likely

to vary the distance of the disengaged eye from the surface on which the image appears.

ROCHESTER, N. Y. Dec. 26, 1883.

MINIMA OF ALGOL FOR 1884.

BY C. W. IRISH.

The following is a table of Algol's Minimum times for 1884 in 90th meridian.

Day	Time.	Day	Time.	Day	Time.	Day	Time.
Jan.	h m	Apr.	h m	Aug.	h m	Nov.	h m
2	5 48 a m	2	11 48 p m	7	3 35 a m	4	0 48 a m
5	2 36 "	5	8 37 "	10	0 24 "	6	9 37 p m
7	11 24 p m	20	4 41 a m	12	9 13 p m	9	6 26 "
10	8 13 "	23	1 30 "	30	2 06 "	21	5 41 a m
25	4 16 a m	25	10 17 p m	September		24	2 30 "
28	1 06 "	28	7 05 "	1	10 55 p m	26	11 19 p m
February		May		4	7 44 "	29	8 08 "
2	6 44 p m	13	3 09 a m	19	3 48 a m	December	
14	5 59 a m	15	11 58 p m	22	0 37 "	14	4 12 a m
17	2 48 "	18	8 47 "	24	9 26 p m	17	1 01 a m
19	11 36 p m	June		30	3 04 "	19	9 49 p m
22	8 25 "	5	1 00 a m	October		22	6 37 p m
March		7	10 30 p m	9	5 30 a m	January	
8	4 29 a m	25	3 23 a m	12	2 19 "	1885	
11	1 18 "	30	9 01 p m	14	11 07 p m	3	5 53 a m
13	10 07 p m	July		17	7 55 "	6	2 44 "
16	6 55 "	18	1 53 a m	November		8	11 31 p m
31	2 59 a m	20	10 42 p m	1	3 59 a m	11	8 21 "

It is proper to say that I have used the period as discovered by Goodricke in 1783, $2^d\ 20^h\ 48.^m8$. Fifteen of these periods are equal to $43^d\ 00^h\ 13^m$ so that at whatever time of day a minimum of Algol is seen, another can be observed at about the same time of the day six weeks one day and thirteen minutes after that. I observed a minimum on Dec. 21, 1883, at 6:30 p. m., with which I took considerable pains to be certain, and it is from this date and time that I have calculated the foregoing table.

I observe that Mr. E. F. SAWYER reports one as having

occurred on Nov. 28, 1883, at about 7 p. m. I sought to check my own observation by his, but found a difference of one hour between us, his being just one hour earlier than my time. As my time was for this meridian I conclude that his was Washington time, or else one of us have made a mistake of one hour in observing.

ASTRONOMY IN HIGH SCHOOLS.

BY THE EDITOR.

Teachers who instruct in the natural sciences, in the high school or in college, usually have had experience in the class-room and know the wants of students. In the elements of chemistry, natural philosophy, or physiology, for example, experiments and varions ways of illustration are used to make clear, vivid and real the fact or principle before the student's mind. Every successful teacher deems such helps necessary, and it is noticeable that officers in charge of the best schools will not allow studies of this class to be taught, without such important aids. This is as it should be. The results of such work judiciously done are always stimulating. Such instruction awakens in the mind of the student an ardent desire for knowledge. It makes him willing and anxious to study and observe that he may know for himself. And these are habits of mind in which the best work can be done as every one knows. In such lines of activity the text-book is chiefly a guide, or hand-book containing information about themes in nature which is to be verified in personal experience and so made personal property as far as possible.

In much the same way, the elements of astronomy may be studied and taught, in the high school and in the academy most profitably. Not even good results, as the writer thinks, can be obtained by keeping a student closely at a text-book and expecting from him only carefully prepared recitations. It is possible that a student may master the elements of a well written book, and still not be able to rec-

ognize the most common of celestial objects that meet the gaze at night. Such knowledge is of little account. It lacks certainty, it is only temporary, and at best, will be very soon forgotten. It is far better to attempt less and master fully and naturally what is undertaken.

These suggestions are made in the hope of interesting teachers of the elements of astronomy in every grade of school in regular study of the heavens by observation.

To do such work most effectively a systematic plan of reading and observation should be adopted and followed faithfully. Such a plan need not consume much time daily. A half-hour every clear night would be ample time to secure large results in the course of a single year. With this amount of observation the student would have gained enough knowledge of the heavens, and such facility in observation as to feel confidence in his own work. He ought then to be able to undertake original work of value to science if he has nothing more than a cheap star atlas and an opera-glass, and these every teacher of astronomy ought to have for the benefit of his classes if nothing more.

We propose now to give a brief outline to indicate a way of beginning the work in mind, and we will suppose the student has little or no knowledge of the geography of the heavens in the outset:—

1. With a star-map before him, a few directions will give him a start, so that with the naked eye he may trace and study the constellations.

(1). The zodiacal constellations locating the equinoxes, solstices, celestial equator, ecliptic, etc.

(2) The northern constellations, colures, prime vertical, prime meridian, pole of the equinoctial, pole of the ecliptic, a general idea of diurnal motion, etc.

(3). As many of the southern constellations as may be seen favorably.

In tracing constellations for the earlier part of this study, it is not desirable to locate stars smaller than the third magnitude, except when necessary to fill out the outline of figures to fix them in mind; in such cases it may be needful

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to use fourth magnitude stars. Very little attention needs to be given to the limits of constellations, for these are always traced from the star-map.

In connection with this outline study of the constellations, it is very helpful to make simple sketches of the figures and locate on the same the stars that have been identified indicating magnitude of all, and the name of those of the first and second magnitudes that can be known. These drawings should be uniform in size, on paper prepared for that purpose, and be submitted to some competent person for inspection and suggestion.

When this naked-eye survey of sky is completed the student has a foundation or frame-work for further and more particular study. The opera-glass may now be used with such advantage as to profit, surprise and greatly please the observer in the re-survey of the work already done. Of the particulars of this more will be said later.

To further this elemental study of the heavens, if a sufficient number of teachers of astronomy in the United States will engage in it, and provide themselves with the necessary inexpensive outfit to carry it on, consisting mainly of a cheap star-atlas and an opera-glass, blanks for observations and drawings, those in charge of the MESSENGER will prepare and print from month to month:—

(1). An outline of work.

(2). Will prepare and print a cheap star-atlas for this work,—not to exceed the cost of one dollar per copy.

(3). Will prepare and forward blanks for observation and drawing.

(4). Will review written work at regular intervals if desired.

(5). Will give directions for the purchase of opera-glasses, that the best may be obtained, and at special rates.

Teachers and other persons interested are invited to correspond with the MESSENGER and send in their names for membership of "The circle for star-studies with the opera-glass."

THE RED SUNSETS.

BY THE EDITOR.

[Continued from page 296, Vol. II.]

At the close of our last, we were speaking of cosmic dust in the atmosphere as the probable cause of the brilliant sunsets which have been so frequent during the last four months, and which still continue with undiminished splendor.

January 9. Mr. BARNARD, Nashville, Tenn., was observing with the telescope in the immediate vicinity of the *Sun*, and saw numbers of small bright particles passing swiftly across the field. He says: "At 3 o'clock P. M., I caught a pretty bright one and followed it for a distance of ten degrees, horizontally towards the north. It was not round, it was not a point, very white; it grew dimmer and dimmer until it faded from view, at the above distance from the *Sun*. Power, fifty-two diameters. The focus of the instrument was adopted sharply to an object less than a mile distant. So whatever the object was, it could not have been more than a few hundred feet above the *Earth*."

Mr. BARNARD further says: "There is scarcely a day but that these objects are visible close to the *Sun*."

There is a very general agreement among physicists and astronomers in the thought that these phenomena are caused either by volcanic or meteoric dust in the atmoshere. All known observations and nearly all theories point to one or the other of these two causes. There is only one prominent exception known to the writer, and that is contained in the suggestion of Professor DANIEL KIRKWOOD, Bloomington, Ind., which is so important and so well stated that we give his own words as follows:

"The prominent facts to be accounted for in the recent twilight phenomena are:—

1. The general diffusion of the matter by which the appearance is produced; so far as known it completely envelopes the atmosphere.

2. Its great altitude; it has been visible two hours after sunset, indicating a height of between fifty and seventy miles.

3. Its persistence; it has been seen continuously, in favorable conditions of the atmosphere, for four or five months.

4. Its rarity; I am not aware that its barometric effect has been perceptible.

The theory which assigns the origin of the phenomena to the volcanic eruption in the Sunda straits on the 26th of August, or to that near the coast of Alaska at an earlier date, or to both, has been received with favor. The difficulties, however, in the way of its adoption are by no means inconsiderable. No similar results, at least to any great extent, had been known to follow volcanic eruptions. If the matter started from Java, August 26, its rate of motion through the atmosphere till its appearance in Brazil was 109 miles an hour. Or, if it be assumed that the appearance in South America was derived from the Alaska outburst we have the additional improbability that results before unknown followed volcanic eruptions in opposite hemispheres at nearly the same time. Again, what force could have maintained the volcanic matter at an altitude of fifty or sixty miles?

Without considering the meteoric hypothesis let us inquire whether any other explanation of the remarkable phenomena is available.

The outer parts of the zodiacal light extend as far as to the *Earth's* orbit. The particles of which it is composed must revolve round the *Sun* in different periods according to Kepler's third law; the parts on the outer rim with nearly the same direction and velocity as the *Earth*. There is nothing absurd in supposing that the latter may sometimes encounter the former and attach more or less of the nebular matter to its own atmosphere. May not the telescopic meteors seen by MR. BROOKS on November 28, have been derived from the zodiacal light?

Professor H. A. NEWTON, Yale college, has given the

subject of meteoric phenomena considerable attention in years past. In a recent private letter he expressed the opinion that the red twilight skies might be due either to volcanic or meteoric material in unusual amounts in the upper air. As to the latter cause, no evidence appears showing that there has come into the atmosphere during the last six months any unusual amount of meteoric matter. The August meteors were not specially abundant; there has been no large meteoric shower, and the number of sporadic and large meteors has not been noticeably great. He further says: It is true that the *Earth* crossed the path of the Biela meteors in November and December; but the red skies began in September nearly three months before we reached the node, and Biela's comet, (what is left of it) is not due at the node till 1885.

On the other hand the volcanic outbursts in Java and Alaska give to the hypothesis of volcanic origin the support of a known active cause occurring at the proper time, and apparently adequate to produce the phenomena."

Professor S. P. LANGLEY, Allegheny observatory Pa., in a late issue of the *N. Y. Tribune* expressed the following view respecting the meteoric theory:

"At first I supposed the sunset matter a local phenomenon, but when the reports showed it to have been visible all over the world, it was obvious that we must look for some equally general cause. We know but two likely ones, and these have been already brought forward. One is the advent of an unusual amount of metoric dust. While something over ten millions of meteorites are known to enter our atmosphere daily, which are dissipated in dust and vapor in the upper atmosphere, the total mass of these is small as compared with the bulk of the atmosphere itself, although absolutely large. It is difficult to state with precision what this amount is. But several lines of evidence lead us to think it is approximately not greatly less than 100 tons per diem, nor greatly more than 1,000 tons per diem. Taking the largest estimate as still below the truth, we must suppose an enormously greater accession than this to supply quantity sufficient to produce the phenomenon in question; and it is hardly possible to imagine such a meteoric inflow unaccompanied with visual phenomena in the form of 'shooting stars,' which would make its advent visible to all. Admitting then, the possibility of meteoric influence, we must consider it to be nevertheless extremely improbable.

A VAST DUST ENVELOPE.*

PROFESSOR S. P. LANGLEY.

In 1878 I was on the upper slopes of Mount Etna, in the volcanic wastes, three or four hours' journey above the zone of fertile ground. I passed a portion of the winter at that elevation engaged in studying the transparency of the *Earth's* atmosphere. I was much impressed by the fact that here, on a site where the air is supposed to be as clear as anywhere in the world, at this considerable altitude, and where we were surrounded by snow-fields and deserts of black lava, the telescope showed that the air was filled with minute dust particles, which evidently had no relation to the local surroundings, but apparently formed a portion of an envelope common to the whole *Earth*. I was confirmed in this opinion by my recollection that Professor PIAZZI SMYTH, on the Peak of Teneriffe, in mid-ocean, saw these strata of dust rising to the height of over a mile, reaching out to the horizon in every direction, and so dense that they frequently hid a neighboring island mountain, whose peak rose above them, as though out of an upper sea. In 1881 I was on Mount Whitney, in Southern California, the highest peak in the United States, unless some of the Alaskan mountains can rival it. I had gone there with an expedition from the Allegheny observatory, under the official direction of General Hazen, of the Signal Service, and had camped at an altitude of 12,000 feet, with a special object of studying analogous phenomena. On ascending the peak of Whitney, from an altitude of 15,000 feet the eye looks to the east over one of the most barren regions in the world. Immediately at the foot of the mountain is the Inyo Desert, and on the east a range of mountains parallel to the Sierra Nevadas, but only about 10,000 feet in height. From the valley the atmosphere had appeared beautifully clear. But from this aerial height we looked down on what seemed a a kind of level dust ocean, invisible from below, but whose depth was six or seven thousand feet, as to the upper por-

*N. Y. Tribune.

tion only of the opposite mountain range rose clearly out of it. The color of the light reflected to us from this dust-ocean was clearly red, and it stretched as far as the eye could reach in every direction, although there was no special wind or local cause for it. It was evidently like the dust in mid-ocean from the Peake of Teneriffe—something present all the time, and a permanent ingredient in the *Earth's* atmosphere.

At our own great elevation the sky was of a remarkably deep violet, and it seemed at first as if no dust was present in this upper air, but in getting, just at noon, in the edge of a shadow of a range of cliffs which rose 1,200 feet above us, the sky immediately about the *Sun* took on a whitish hue. On scrutinizing this through the telescope it was found to be due to myriads of the minutest dust particles. I was here at a far greater height than the summit of Etna, with nothing around me except granite and snow-fields and the presence of this dust in a comparatively calm air much impressed me. I mentioned it to Mr. Clarence King, then director of the United States Geological Surveys, who was one of the first to ascend Mount Whitney, and he informed me that this upper dust was probably due to the "loess" of China, having been borne across the Pacific and a quarter of the way around the world. We were at the summit of the continent,and the air which swept by us was unmingled with that of the lower regions of the *Earth's* surface. Even at this altitude the dust was peculiarly present in the air,and I became confirmed in the opinion that there is a permanent dust shell inclosing the whole planet to the height certainly of about three miles (where direct observation has followed it,) and not improbably to a height even greater; for we have no reason to suppose that the dust carried up from the *Earth's* surface stops at the height to which we have ascended. The meteorites, which are consumed at an average height of twenty to forty miles, must add somewhat to this. Our operations with special apparatus on Mount Whitney went to show that the red rays are transmitted with greatest facility through our air and rendered it ex-

tremely probable that this has a very large share in the colors of a cloudless sky at sunset and sunrise, these colors depending largely upon the average size of the dust particles.

It is especially worth that notice, as far as such observations go, we have no reasons to doubt it as the finer dust from the earth's surface is carried up to a surprising altitude. I speak here, not of the grosser dust particles, but of those which are so fine as to be individually invisible, except under favoring circumstances, and which are so minute that they might be an almost unlimited time in settling to the ground, even if the atmosphere were to become perfectly quiet. I have not at hand any data for estimating the amount of dust thrown into the air by such eruptions as those which recently occurred in Java and Alaska. But it is quite certain, if the accounts we have are not exaggerated that the former alone must have been counted by millions of tons and must in all probability have exceeded in amount that contributed by meteorites during an entire year. Neither must it be supposed that this will at once sink to the surface again. Even the smoke of a conflagation so utterly insignificant, compared with nature's scale, as the burning of Chicago was, according to Mr. Clarence King, perceived on the Pacific Coast; nor is there any improbability that I can see in supposing that the eruption at Krakota may have charged the atmosphere of the whole planet (or at least of a belt encircling it) for months with particles sufficiently large to scatter the rays of red light and partially absorb the others, and to produce the phenomenon that is now exciting so much public interest. We must not conclude that the cause of the phenomenon is certainly known. It is not. But I am inclined to think that there is not only no antecedent improbability that these volcanic eruptions on such an unprecedented scale are the cause, but that they are the most likely cause which we can assign.

Professor H. C. WILSON'S observations and drawings of the Pons-Brooks' Comet, for January, contain new and interesting features. They will appear next month.

EDITORIAL NOTES.

Our leading article on the nucleus of the Great Comet of 1882, by Professor H. C. WILSON of the observatory of Cincinnati is esteemed an important part of the comet's history. The illustrations and table-work make its reading easy and meaning clear.

WILLIAM C. WINLOCK, assistant astronomer, Naval observatory, Washington, D. C., recently published a full series of observations of the Great Comet of 1882, extending from Sept. 19, 1882 to April 4,1883. Five full pages of lithograph plates show beautifully the character and changes of the nucleus, and the outlines of the 'outer envelopi' and the tail.

At the December meeting of the Royal Astronomical Society,* Mr. RAYNARD read a paper "On a Narrow Belt on the Planet *Saturn*." With an 18-inch glass reflector, it was seen to stretch across the disc slightly fading away towards either limb. It was almost as easily observed as the Cassini division on the ring. It has been recently seen by different persons at different times. This is an important observation because narrow belts are very rare on *Saturn*. We are not aware that such phenomena have been before noticed at all in the recent study of the planet.

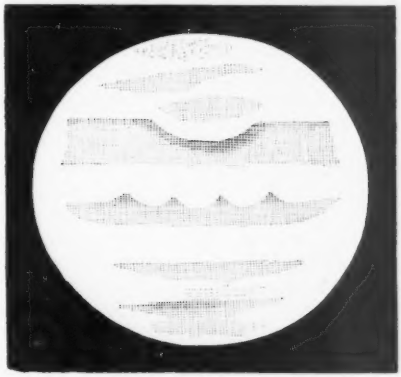
Mr. MATTIEN WILLIAMS of England is inclined to the view that our red sunset displays are due to clouds of meteoric dust. He has collected as much as seventy-five ounces of snow and tested the same with hydrochloric acid and he finds the usual indications of iron, except that the color is more green than that obtained from pure iron. The presence of nickel is suspected, though not yet proved. There was also the presence of the magnetic oxide of iron which was clearly shown by the decided action of the magnet on the larger granules of the deposit. The precipitate from snow-fall ought to give important evidence in determining whether this atmospheric dust is of the terrestrial or the meteoric kind.

Text-books on astronomy very generally compare the belt formations on the planet *Jupiter* to that of clouds in the *Earth's* atmosphere, and convey the impression that great changes in them are common, and that new belts may form in a very few hours. Observations do not warrant this view. The physical condition of the planet, in all probability, is not like that of the *Earth*, but rather more nearly like

*Observatory.

that of the *Sun*, a gaseous semi-liquid or viscious mass; elliptical in form, definite in outline with a disc, at least, partly self-luminous. Changes in the configuration of the surface that appear from hour to hour are mainly due to the rapid rotation of the planet on its axis, and also to the fact that the disc is nearly a hemisphere, and that objects seen on the limb look very different while passing the central meridian.

The accompanying cut represents a view of *Jupiter* as seen by R. M. LUTHER of Philadelphia, Pa. Dec. 23, 1883, at 11^h in the evening. Aperture of telescope, 2.857 inches; powers 130 and 180.



TELESCOPIC (INVERTED) VIEW.

The color of the great equatorial belt had a yellowish tinge, and the depression in the southern limit of it opposite the faint great spot is very marked, more so than in any other drawing, that we have seen for 1883. The great spot has remained nearly stationary, but the southern limit of the great equatorial belt has drifted to the south, apparently piling itself up around the spot, at a considerable distance away, as if obstructed by some repelling influence from the spot.

There are other interesting features of change in the surface derived from a careful study of the small white spots by the aid of the telescope and the micrometer.

β^1 CAPRICORNI.

The remarks of Mr. SAWYER in the January MESSENGER prove what I had no doubt of, and that is the duplicity of the 7th magnitude star just preceding Beta *Capricorni*. I believe the star is Beta^1 *Capricorni*. I hope the observations of Mr. SAWYER and myself will cause the star to be examined with some of the larger instruments when it is again favorably situated. E. E. BARNARD.

The comet is moving rapidly southward, and away from the *Earth* and the *Sun*, and hence its brightness will slowly diminish from day to day until lost to sight or below the horizon in northern latitude. Its chief physical characteristics to be observed at this return are already a matter of record, and not much more of special interest may be expected in its waning departure, even to observers in southern latitudes who may follow it with the telescope during the whole of next month. It was discovered by PONS of Marseilles, July 20, 1812, was visible about ten weeks, being seen by the naked eye early in September of that year. The orbit then computed by ENCKE made its period 70.6 years which fixed the next passage of perihelion in September, 1884, with a few years of uncertainty. It will be remembered that Professor BROOKS first saw it September 1, 1883, when it was exceedingly faint. It was however soon ascertained that the comet was the old visitor of 1812 in sight a little sooner than expected. About Jan. 15, it was nearest the *Sun*, 70 millions of miles distant, and about an equal distance from the *Earth* at the same time. A few days earlier it passed nearest the *Earth* at a distance of 53 millions of miles approximately. The first days of February it will pass into the southern constellation, *Sculptor*, and in March through *Phœnix* and *Horologium*. It will then be as faint as at the time of discovery, and soon after beyond the reach of the most powerful telescope.

The following ephemeris may be of service to those in southern latitudes desiring to follow it who have an ambition to try their eyes and telescopes on a celestial object, known to be gradually vanishing from sight:

BRUSSELS' EPHEMERIS.

1884.	R. A. h m	Decl. ° ′	Brightness.
Feb. 2	0 34	−28 3	2.3
11	1 2	−37 2	1.5
21	1 23	−43 7	1.0
Mar. 2	1 43	−48 5	0.6
12	2 2	−53 0	0.4
22	2 26	−56 2	0.2

The American computations put the time of passing perihelion about ten days later than that from which the above ephemeris is derived.

In the January number of the MESSENGER it was reported that Professor DAVIDSON had observed the comet with the naked eye, Dec. 1, which was thought to be the earliest record of its being seen without the aid of the telescope. I have a note for Nov. 28, which says: "To-night at 7h the comet is just visible to the naked eye." In the 5-inch telescope, the same evening, I have:—"It is quite bright in the telescope, the tail is very difficult to see, not really certain that it was quite seen. The tail certainly has faded since last night." E. E. B.

The following elements and ephemeris of planet (235) have been computed by Professor E. FRISBY from observations made at the U. S. Naval Observatory, Washington, by commander W. T. SAMPSON, on the evenings of December 1, 6 and 21, 1883.

[Communicated by Rear Admiral Shufeldt, superintendent.]

	Wash. M. T.	App. α	App. δ
	h m s	h m s	° ′ ″
Dec. 1	13 13 19.5	3 16 31.80	+ 15 51 0.8
" 6	11 59 7.0	3 12 39.75	+ 15 50 6.1
" 21	12 12 46.0	3 3 48.88	+ 15 57 11.9

From which are derived the following elements:

Epoch. 1883 Dec. 21.5 Gr. M. T.

M =	275 3 21.2	Mean Equinox 1883.0
Ω =	67 13 21.2	
$\pi - \Omega$ =	86 50 22.8	
i =	8 34 28.1	
φ =	4 10 44.2	
$log.\ a$ =	0.471817	
μ =	695″.471	

Comparison with the middle place gives,

$$\delta\lambda \cos\beta = 0.0$$
$$\delta\beta = 0.0$$

$$X = [9.995856]\, r \sin(v + 243\ 49\ 53.8)$$
$$Y = [9.951720]\, r \sin(v + 157\ 48\ 10.8)$$
$$Z = [9.669480]\, r \sin(v + 138\ 36\ 6.8)$$

1884.0

The following positions are computed for Greenwich midnight.

1884 Gr. $12^h.0$	App α			App δ		Log Δ
	h	m	s	°	′	
Jan. 3	3	0	23	+16	17.4	0.3585
7	3	0	12	16	26.7	0.3671
11	3	0	24	16	37.3	0.3758
15	3	0	59	16	49.1	0.3846
19	3	1	57	17	2.3	0.3934
23	3	3	17	17	16.5	0.4024
27	3	4	59	17	31.8	0.4113
31	3	7	2	+17	48.1	0.4201

Professor G. M. PHILLIPS, principal of State Normal school, West Chester, Pa., calls our attention to an erroneous statement respecting the line of change of time between the Intercolonial and the Eastern time districts. In the December number of the MESSENGER, it was stated that the line of change passed through the state of Maine. Professor PHILLIPS says the entire state of Maine belongs to the district of Eastern time. He speaks from an authoritative map and is doubtless right; we have no such map now before us.

Professor SWIFT, Warner observatory, Rochester, N. Y., on the evening of Dec. 29, caught the comet in one of its recent curious freaks. We have seen no notice of such an observation at an earlier date. We give his own description:

TELESCOPIC (INVERTED) VIEW.

"At 7 o'clock this enening I had a fine view for a few minutes (cut short by the clouds) of the Pons-Brooks' comet. I send you a drawing of it as seen through the 16-inch refractor of this observatory.

The coma is very large, as is also the nucleus, while the tail in comparison with the size of the head is very narrow. I could trace it to a distance of 6° or 8° and it is perfectly straight.

The principal object of this communication and of the sketch is to call attention to the secondary tail which was for the first time observed. It is exceedingly difficult to see. It appeared 3° in length and like the principal tail narrow and straight. I shall watch with interest the further development of the new tail if indeed it is new."

BROOKS' (1812) COMET.

E. E. BARNARD, Vanderbilt university, Nashville, Tenn., favors us with full notes of observations of the comet, from which the following items of interest are taken:

First seen with the naked eye, Nov. 28. The tail was less bright in the 5-inch telescope than the night before.

Nov. 29. Condensation of coma noticed.

Nov. 30. A point like nucleus seen, tail brighter than ever before and one degree long.

Dec. 2. Comet very much brighter; tail 2¼° long, very straight, not perceptibly brighter along the axis. A large spot is seen in the head which contains a tiny nucleus.

Dec. 25. To the naked eye at 6 ^{h}, the brightness of the comet is fully equal Zeta *Cygni*. The tail in the 5-inch telescope is distinct, long and slim, and brighter along the axis. The nucleus is bright and slightly yellowish. The head is nearly round and has a beautiful pearly color.

Dec. 26. By naked eye comparison at about the same altitude, the

the comet is nearly as bright as the nebula of *Orion*, a little larger, but not so definite. The tail can be traced for 10° approximately.

Dec. 28. A faint tail could be traced 8° with the unaided eye. The nucleus is possibly a little smaller and sharper.

Jan. 9, 1884. By naked eye comparison, the brightness of the comet is between that of Epsilon and Zeta *Pegasi*. At 7ʰ it and the nebula of *Orion* were almost indentical in appearance.

OBSERVATIONS OF PLANET (235).

Observations made at the Naval Observatory, Washington, by W. T. SAMPSON, with the 9.6-inch Equatorial.

1883	M. T. Wash.	Planet — * $\Delta\alpha$	$\Delta\delta$	No. of Com.	Planet α appr.	log. $(\rho\times\Delta)$	Planet δ appr.	log $(\rho\times\Delta)$
	h m s	s	″		h m s		° ′ ″	
Dec. 1	13 13 19.53	−1 23.71	−1 54.4	20-4	3 16 31.86	9.48696	15 51 0.8	0.587981
" 3	11 18 40.82	−2 57.16	−2 31.0	15-3	3 14 58.36	9.49081	15 50 24.2	0.542661
" 5	10 47 54.80	−4 28.71	−2 52.4	25-5	3 13 26.78	9.83426	15 50 2.9	0.588111
" 6	11 58 6.99	+4 0.85	+0 36.6	10-2	3 12 39.75	9.83656	15 50 6.2	0.561032
" 9	15 17 19.69	+1 45.81	−2 9.0	15-3	3 10 24.14	9.67322	15 50 16.5	0.699313
" 18	8 9 50.85	−3 23.51	+1 59.2	25-5	3 5 14.84	9.13307	15 54 24.6	0.544383
" 21	11 12 46.03	−3 7.88	−7 29.7	20-4	3 3 48.88	9.41122 n	15 57 11.9	0.570154
" 28	10 23 1.02	−4 29.84	+1 19.8	15-3	3 1 26.89	9.34634	16 6 1.1	0.558114
" 29	8 01 31.58	−4 42.96	+2 58.9	15-3	3 1 13.77	8.7524 n	16 7 39.5	0.532284
Jan. 2	7 49 30.55	−2 53.70	−5 12.8	20-4	3 0.55	9.60848	16 17 4.6	0.523557

Star.	α 1883.0		δ 1883.0		Authority.
	h	m s	°	′ ″	
1	3	17 50.48	15	52 42.8	Bonn, 428.
2	3	8 33.92	15	49 16.1	Weise, III 152.
3	3	8 33.33	15	52 12.2	Weise, III 151.
4	3	5 57.79	16	4 28.2	Weise, III 81.
		1884.0		1884.0	
5	3	3 47.75	16	22 17.9	Weise, III 20.

The table of dates showing the minima of that wonderful variable star *Algol* kindly furnished by C. W. Irish will interest some of our readers who have been seeking such information.

Nearly all subscriptions to Vol. III. are now due and our patrons are requested to be prompt in remitting.

It is to be hoped that many old subscribers will also send one new name, at least, if the MESSENGER is deemed worthy of such support.

Subscriptions were received during the month of January from the following named persons:

John C. Ludwig, Cape Girardeau, Mo., John R. Hooper, Baltimore, Md., Geo. R. Vickers Jr. Baltimore, Md., Miss Anna Winlock, Harvard Coll. observatory, Cambridge, Mass., Dr. M. S. Dowling, Leslie, Mich., W. H. Numsen, Baltimore, Md., Professor H. B. Perkins, University, Appleton, Wis., John H. Eadie, Bayonne, N. J., Geo. W. Hough, Ypsilanti, Mich., John O. Williams, Springfield, Ill., Professor C. S. Howe, Buchtel College, Akron, O., Professor John Haywood Otterbein university, Westerville, O., Isaac P. Guildenschuk, Rochester, N. Y., Reading Room, Excelsior, Minn., Professor S. P. Langley, Allegheny observatory, Pa., Willis S. Barnes, Solon, Ind., Rev. G. Chapman Jones, Buffalo, N. Y., Charles H. Scales, Toronto, Ontario, Ca., Geo. Gildersleve, Baltimore, Md., J. H. Brithart, Indiana, Pa. S. W. Burnham, Chicago, Ill., J. D. Elliott, St Louis, Mo., University Library, East Minneapolis, Minn., J. D. Devor, Elkhart, Ind.

THE PLANETS.

[In Central Time.]

The red skies of morning and evening still continue. Physicists attribute these strangely beautiful phenomena to one of three causes: (1) volcanic dust, (2) meteors, (3) nebulous matter like that of the Zodiacal Light. The spectroscope shows that the colors seen are not due to watery vapor in the atmosphere. They evidently come from matter in a gaseous form, or in finely divided state, and great extremes of temperature do not seem to modify their intensity in the least. They were first noticed Aug. 28 and have since been seen very frequently in all parts of the world.

The Zodiacal Light during the last week of January was very bright extending almost to the meridian. February will be favorable for observations of it.

The mean local time of the observatory is *slower* than 90th meridian time $12^m 35.89^s$.

Feb. 1. The *Sun* is *slower* than the clock on local mean time, 13^m 47.1^s. Feb. 11, the difference is greatest being 14^m 27.75^s.

Feb. 29. The equation is 13^m 36.76^s.

The phases of the moon occur as follows: Feb. 3, 11^h 57.2^m p. m.; full moon, Feb. 10, 10 47.9^m p. m; last quarter, Feb. 18, 9^h 12.6^m p. m; new moon, Feb. 26, 0^h 35.1^m p. m. The moon will be in perigee, Feb. 4, 3^m p. m.; also, Feb. 29, 12^s. In apogee Feb. 18, 2.3^m a. m.

Mercury was in inferior conjunction January 20, it will be in greatest elongation, west, Feb. 13, $10^h\ 8^m$; 26° 12′. It will be then 20° in south declination and hence not very favorable for naked eye view. Feb. 5, its diameter is 8″; Feb. 25, 5.8″.

Feb. 5th, it rises, $5^h\ 38^m$ morning; 15th, $5^h\ 38^m$; 25th, $5^h\ 43^m$.

Venus is an evening star, in south declination and moving northward. During February its diameter ranges from 13.2″ of arc to 15.2″; its illuminated disc from .84 to .78 and its brilliancy from 67.5 to 76 5.

Its time of setting is respectively, Feb. 5th, $7^h\ 50^m$; 15th, $8^h\ 16^m$; 25th, $8^h\ 40^m$.

Mars is in favorable position for early evening observation. Its ruddy color in the eastern sky will seize the attention of those unused to star-gazing.

Feb. 1. *Mars* was in opposition, and hence nearest the *Earth* for this year, The planet is however now near the aphelion. When in perihelion and also in opposition, it is then nearest to the *Earth*. This was the case in 1877, when Professor HALL of the Naval observatory, discovered its tiny satellites, the planet then being only 35 millions of miles away, Such favoring circumstances will not again occur until 1892.

About Feb. 1, is the most favorable time of the year to observe the satellites; but it is very doubtful if they will be seen at all, this year, for the planet must be 60 millions of miles distance at opposition. Its time for rising for Feb. 5, 15, 25, are respectively, $4^h\ 4^m$; $3^h\ 5^m$; $2^h\ 13^m$; in the evening. Its average angular diameter is 13″ of arc. The apparent illuminated disc is nearly unity for this month. The numbers which represent the apparent disc, for any time, are the versed sines of the illuminated portion divided by the apparent diameter.

Minor Planets. The last discovered (No 235) was by J. Palisa, Vienna, Austria, Nov. 28, 1883. It is of the twelfth magnitude. Particular study of the Asteroid belt reveals the interesting fact that the small planets are not evenly distributed over the space between *Mars* and *Jupiter*; but that their orbits lie in groups with chasms between. The divisions of *Saturn's* rings and the grouping of the asteroids are probably due to like causes,

Jupiter and *Saturn* are in favorable positions for observation.

BOOK-NOTICES.

Elementary Geometry, new edition, including plane, solid and spherical Geometry, with practical exercises. By Edward Olney, Professor of Mathematics in the University of Michigan, Messrs. Sheldon & Co., publishers, New York and Chicago, 1883, pp. 333.

The authors school edition of elementary geometry, published in 1872, we have used in the class-room more or less for nine years. In

most respects his plan and method have proved excellent. The introductory part, containing about sixty pages of definitions, illustrations, examples and exercises about, and upon, the main topics of geometry has always been thought by us most needful to prepare the students for the work.

In the new edition this part has been omitted, and what was necessary to make the work complete has been scattered through the book under appropriate subjects. In our judgment, this is a loss in the arrangement of the book rather than a gain. The average student will certainly be put at a disadvantage by it.

In other things the new edition is much better than the old, especially in these particulars: Philosophical arrangement; simplified and yet comprehensive; parallels better treated; original investigation provided for; good checks against mere memory work; improved method of treating incommeusurables, and generally those special adaptations to the class-room that plainly show the judgment and experience of the teacher as well as the skill of the mathematician.

A treatise on plane and spherical Trigonometry, by William Chauvenet formerly Professor of Mathematics and Astronomy in Washington, University, St. Louis, ninth edition, Messrs. J. B. Lippencott & Co. publishers, pp. 256.

It is most gratifying to notice that the study of the higher mathematics, in recent years, is receiving special attention in the great educational institutions of this country. This might be expected in the older colleges and universities, but it is surprising to know what is being done in those recently founded on a liberal plan and with munificent endowments. Harvard, Michigan, Yale and the Naval Academy have been exemplary for years, but Johns Hopkins is evidently now taking the lead in modern research in pure mathematics There is reason for this advancemant in the study of mathematics. Almost every branch of science is already so far in its development as to need and almost necessarily depend on the mathematics for further progress. The higher mathematics is the one efficient instrument by which proper generalization can be secured.

As a complete introduction to the study of trigonometry, Chauvenet's work is undoubtedly the best. The student who masters it has a ready knowledge of the science that is most pleasurable and efficient in all common applications. Our experience in its use in post-graduate classes has been gratifying. Students are able to undertake original work and they like to do it. They soon gain such a familiarity with the principles of generalization and transformation that work which is either long or complicated is no longer drudgery. This book may well find a place in the library of every teacher of mathematics.

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